BNL-94808-2011-AB

EXAMINATION OF ENTRAINMENT-MIXING MECHANISMS USING A COMBINED APPROACH

Chunsong Lu[1,2], Yangang Liu[1], and Shengjie Niu[2]

[1] Atmospheric Sciences Division, Brookhaven National Laboratory (BNL), New York, USA 11973
[2] School of Atmospheric Physics, Nanjing University of Information Science and Technology (NUIST), Jiangsu, China 210044

For presentation at
The Second Science Team Meeting of the
Atmospheric System Research (ASR) Program,
San Antonio, TX
March 28-April 1, 2011

Environmental Sciences Department/Atmospheric Sciences Division
Brookhaven National Laboratory

U.S. Department of Energy
Office of Science

ABSTRACT

Turbulent entrainment-mixing mechanisms are studied with the aircraft measurements of three drizzling and two non-drizzling stratiform clouds collected over the U. S. Department of Energy's Atmospheric Radiation Measurement Southern Great Plains site during the March 2000 cloud Intensive Observation Period. The inhomogeneous entrainment-mixing process occurs both near cloud top and in the middle level of a cloud, and both in the non-drizzling clouds and non-drizzling legs in the drizzling clouds. The inhomogeneous entrainment-mixing process occurs much more frequently than the homogeneous entrainment-mixing process, and most cases of the inhomogeneous entrainment-mixing process are close to the extreme scenario whereby the cloud droplet number concentration varies substantially but the volume-mean radius remains roughly constant (Figure 1). We argue that the dominance of inhomogeneous entrainment-mixing mechanism is related to the difference between the transition length and Kolmogorov microscale; the scale differences are smaller for the legs affected by the inhomogeneous entrainment-mixing process compared with the leg affected by the homogeneous process. Filaments smaller than the spatial resolution of the instrument are indirectly confirmed, which also partially contribute to the dominance of inhomogeneous entrainment-mixing mechanism. Further analysis indicates that the processes of homogeneous and inhomogeneous entrainment-mixing likely conspire to affect ambient clouds; the difference lies in the different degrees of their domination. A combined study of microphysical relationships, dynamic and thermodynamic structures is recommended for thorough analysis of entrainment-mixing processes.